Design And Analysis of Regular And Vertical Irregular Building By Using E-TABS

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ABSTRACT: To study building behavior of multi-story structures always depends on its strength, durability, stiffness and adequacy of the regular configuration of the structure. Methods: The analysis always depends on the forces and importance on the cost of analyzing the structure. Creating the 3D building model for both linear and non-linear dynamic method of analyses. Understanding the seismic behavior of Setback buildings and Co-relating the seismic behavior of the Setback building with that of a building without Setback finally comparing the regular building behavior of building with a setback at top most 5 stories to that of the building with a setback at each floor level. Study the influence of vertical irregularity in the building when compare to regular building . Findings: The present study is limited to reinforced concrete framed structure designed for setback and regular building of loads (DL, LL & EL). The behavior of 20-Storied buildings with and without setbacks was studied. The buildings were analyzed using Time History Analysis and Response Spectrum Method and. Novelty: The effect of Setback is studied considering the parameters such as Time Period, storey drifts, Displacements, Storey Shears, Bending Moments and Shear Forces and correlated with the building without a setback.

keywords : Time Period, storey drifts, Displacements, Storey Shears, Bending Moments and Shear Forces ETABS etc.

I. INTRODUCTION

Structure is subjected to Earthquake seismic forces are developed during earthquake. Structure is experienced there seismic forces. Seismic forces develops the seismic waves there waves reaches the structure during earthquake. They produce ground motions in the structure. Earthquake is the rapid movement of the earth surface. It takes place naturally at or below the surface of the earth. The earthquake takes place the layers of the soil surfaces in the earth. The earthquake takes place the layers of the soil surfaces in the earth also displaced. When the structure is subjected to ground motions during earthquake the vibrations are occurred the structure will be responds. When the ground motions occurred it should effects the structure in three perpendicular directions. In the three perpendicular directions one is vertical direction (Z) and other two are off horizontal directions (X & Y).The ground motions are occurred the structure get shaking in three directions. The structure is mostly affected by the horizontal direction of shaking. All the structures are designed to satisfy the gravity loads that acted in vertical directions. In the design specifications safety factors to be considered for the design because of this most of the structures tend to be adequately protected against vertical shaking. In general building structures are not susceptible particularly to the vertical ground motions. But it effects to be considered in mind in the design of RCC structural members like RCC columns, steel column connections and beams. Acceleration in the vertical direction also considered in structures with the large span and also stability of structures also is considered in the overall stability analysis of structures. When the building structure is designed for considering only the vertical ground motions in general this design is not safe. This not satisfies the horizontal ground shaking. In generally the forces generated due to Horizontal ground motions of earth is taken as important for the design of the structures. Therefore it is important that the structure is designed to resist the forces acting horizontally due to earthquake. When the building structure is resist on soil surface.

Minimum required side setbacks for residential building:

Lot width	With height of a building	Nominal setbacks
6m – 10m	Up to 5.5m	900mm
10m – 18m	Up to 4.5m	900mm
16m – 24m	Up to 4.5m	1.5m
24m	At any height	2.5m

OBJECTIVE OF THE STUDY

- In this study focus on the behavior of structures during earthquake having irregularities in plan and having same area.
- To study the parameters of storey shear, storey displacements, Maximum storey drift of all models during earthquake
- To study the Non Ductile behavior of the structure of the building with regular and vertical irregular structures.
- To find the behavior of the building under the Dynamic and Static behavior of the Building under Response spectrum analysis.

SCOPE OF THE STUDY

The present examination is constrained to fortified cement (RC) multi-storeyed building outlines with mishaps. Difficulty structures up to 20 stories with various degrees of abnormality are considered. The structures are accepted to have mishap just one way.

The arrangement asymmetry emerging out of the vertical geometric abnormality entirely demands an explanation from for three-dimensional investigation legitimately for torsion impacts. This isn't considered in the present examination, which is restricted to investigation of plane misfortune outlines. Albeit distinctive story numbers (up to 20 stories), cove numbers (up to 10 straights) and anomaly are viewed as, the inlet width is confined, to 6m and story stature to 3m. It will be suitable to consider versatile load design in powerful examination with a specific end goal to incorporate the impact of dynamic basic yielding. Be that as it may, for the present investigation just settled load dissemination shapes are intended to use in powerful examination, with a specific end goal to keep the methodology computationally straightforward and appealing for outline office condition. Soil structure communication impacts are not considered.

II.LITERATURE REVIEW

Rajeeva and Tesfamariam et all,. (2012) The Fragility based seismic vulnerability of structures with consideration of soft -storey (SS) and quality of construction (CQ) was demonstrated on three, five, and nine storey RC building frames designed prior to 1970s. Probabilistic seismic demand model (PSDM) for those gravity load designed structures was developed, using non-linear finite element analysis, considering the interactions between SS and CQ. The response surface method is used to develop a predictive equation for PSDM parameters as a function of SS and CQ. Result of the analysis shows the sensitivity of the model parameter to the interaction of SS and CQ.

Sarkar et al. (2010) The proposed a new method of quantifying irregularity in vertically irregular building frames, accounting for dynamic characteristics (mass and stiffness). The salient conclusions were as follows: A measure of vertical irregularity, suitable for stepped buildings, called regularity index‘, is proposed, accounting for the changes in mass and stiffness along the height of the building. An empirical formula is proposed to calculate the fundamental time period of stepped building, as a function of regularity index.

Karavasilis et al. (2008) Has studied the inelastic seismic response of plane steel moment-resisting frames with vertical mass irregularity. The analysis of the created response databank showed that the number of storey’s, ratio of strength of beam and column and the location of the heavier mass influence the height-wise distribution and amplitude of inelastic deformation demands, while the response does not seem to be affected by the mass ratio.

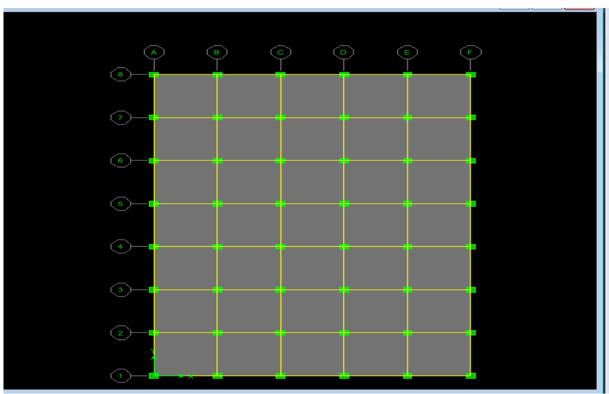
Athanassiadou et all,.(2008) They concluded that the effect of the ductility class on the cost of buildings is negligible, while performance of all irregular frames subjected to earthquake appears to be equally satisfactory, not inferior to that of the regular ones, even for twice the design earthquake forces. DCM frames were found to be stronger and less ductile than the corresponding DCH ones. The over strength of the irregular frames was found to be similar to that of the regular ones, while DCH frames were found to dispose higher over strength than DCM ones. Pushover analysis seemed to underestimate the response quantities in the upper floors of the irregular frames.

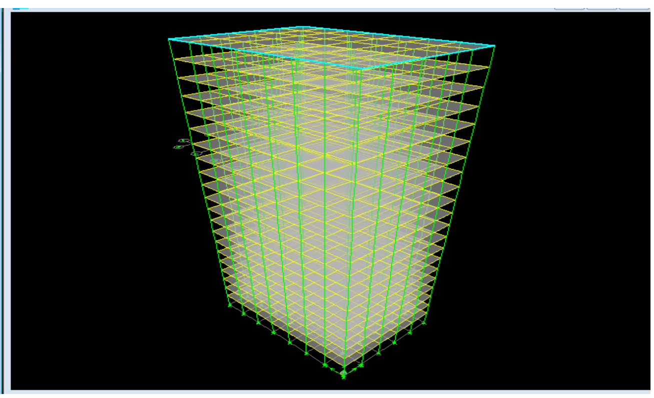
III. METHODOLOGY

STATEMENT OF THE PROJECT

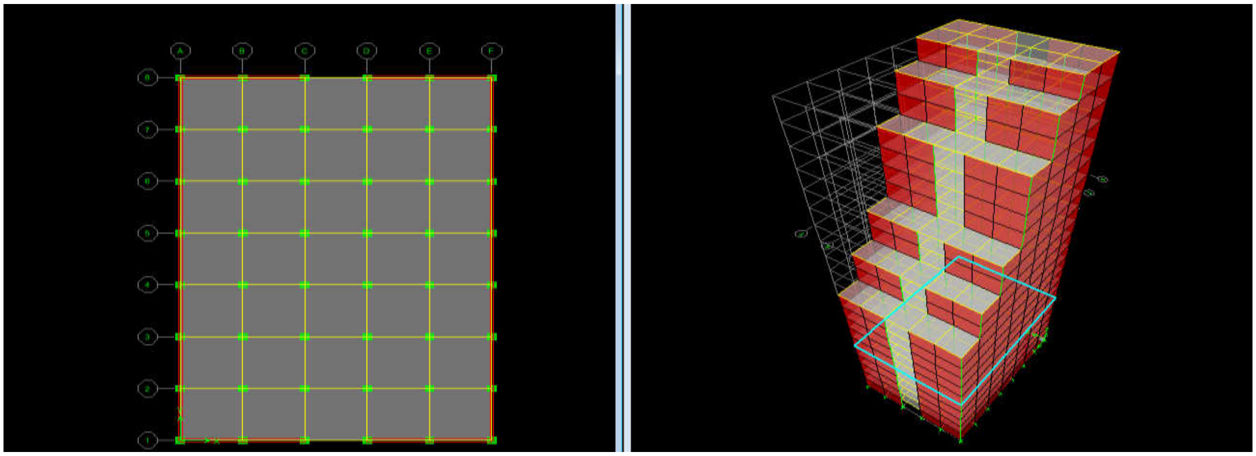
SL No	Structural details	Type of location
1	Utility of Buildings	Residential Building
2	No of Storey	G+20
3	Area	768 sq.mts
4	Height of Building	64 mts
5	Shape of the Building	Rectangle, vertical
6	Types of Walls	Masonry wall – 230 mm thickness
7	**Geometric Details** Ground Floor	4 mts
	Story to story height	3.0 mts
	Beam	0.45X0.50 mts
	Columns	0.55X0.45 mts
	Slab	0.150 mts
8	**Material Details** Concrete Grade	M40 (All structural elements) FE 415 (All structural elements)
	All Steel Grades	
9	Type Of Construction	R.C.C FRAMED STRUCTURE
10	Place of construction	Bhuj - Gujarat.
11	Loads considered in Buildings	Dead load, Live load, Earthquake ,Wind load
12	Wind Speed	44 m/s (Hyderabad wind speed)
13	Seismic Zone	Zone – V (Bhuj)
14	Method of Analysis	RESPONSE SPECTRUM ANALYSIS
15	NON Ductile properties	5 (Response reduction factor)
17	IS codes used	IS456 :2000,IS1893:2002,IS 16700:2017,IS 875:1987 (Part 1, Part 2, Part 3)

REGULAR BUILDING





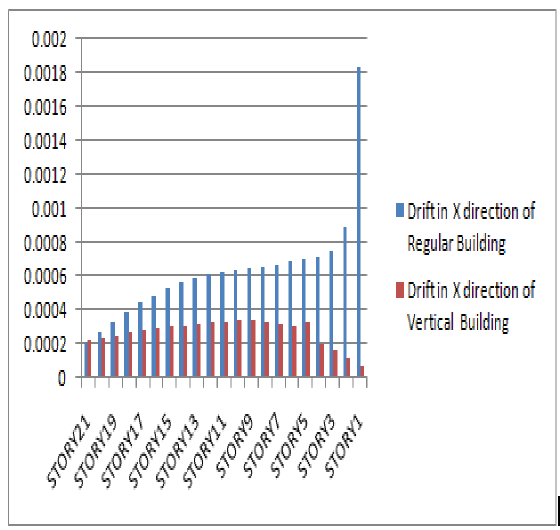
VERTICAL BUILDING



IV.RESULTS AND ANALYSIS

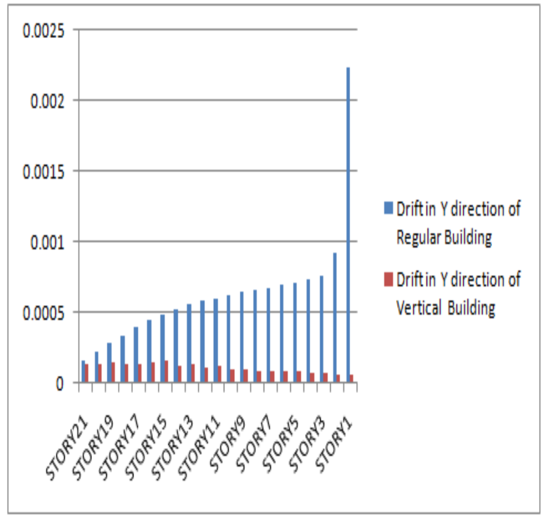
DRIFT IN X DIRECTION

Story	Load	Loc	Drift in X direction of Regular Building	Drift in X direction of Vertical Building
STORY21	RSA	Bottom	0.000213	0.000229
STORY20	RSA	Bottom	0.000271	0.000238
STORY19	RSA	Bottom	0.000333	0.00025
STORY18	RSA	Bottom	0.000391	0.000268
STORY17	RSA	Bottom	0.000442	0.00028
STORY16	RSA	Bottom	0.000488	0.00029
STORY15	RSA	Bottom	0.000527	0.0003
STORY14	RSA	Bottom	0.000559	0.00031
STORY13	RSA	Bottom	0.000585	0.000319
STORY12	RSA	Bottom	0.000607	0.000327
STORY11	RSA	Bottom	0.000624	0.000333
STORY10	RSA	Bottom	0.000638	0.000346
STORY9	RSA	Bottom	0.000651	0.000336
STORY8	RSA	Bottom	0.000664	0.000328
STORY7	RSA	Bottom	0.000676	0.000314
STORY6	RSA	Bottom	0.000689	0.000302
STORY5	RSA	Bottom	0.000701	0.000326
STORY4	RSA	Bottom	0.000716	0.000205
STORY3	RSA	Bottom	0.000748	0.000159
STORY2	RSA	Bottom	0.000899	0.000115
STORY1	RSA	Bottom	0.001841	0.000071



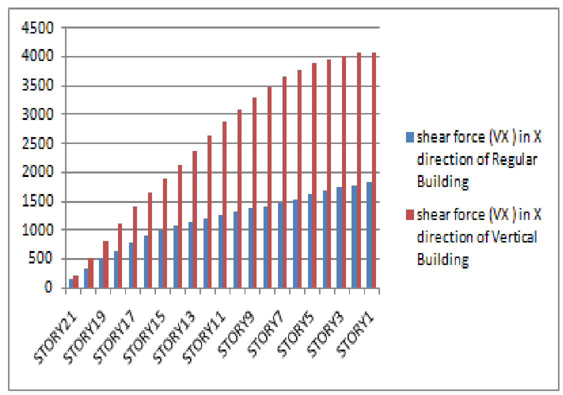
DRIFT IN Y DIRECTION

Story	Load	Loc	Drift in Y direction of Regular Building	Drift in Y direction of Vertical Building
STORY21	RSA	Bottom	0.000158	0.000138
STORY20	RSA	Bottom	0.000219	0.000139
STORY19	RSA	Bottom	0.000283	0.000148
STORY18	RSA	Bottom	0.000343	0.000141
STORY17	RSA	Bottom	0.000398	0.000143
STORY16	RSA	Bottom	0.000447	0.000146
STORY15	RSA	Bottom	0.000489	0.000158
STORY14	RSA	Bottom	0.000526	0.000129
STORY13	RSA	Bottom	0.000557	0.000137
STORY12	RSA	Bottom	0.000584	0.000113
STORY11	RSA	Bottom	0.000606	0.000119
STORY10	RSA	Bottom	0.000626	0.0001
STORY9	RSA	Bottom	0.000645	0.000095
STORY8	RSA	Bottom	0.000663	0.000092
STORY7	RSA	Bottom	0.00068	0.000089
STORY6	RSA	Bottom	0.000698	0.000086
STORY5	RSA	Bottom	0.000716	0.000082
STORY4	RSA	Bottom	0.000734	0.000076
STORY3	RSA	Bottom	0.000765	0.00007
STORY2	RSA	Bottom	0.00092	0.000063
STORY1	RSA	Bottom	0.002233	0.000058



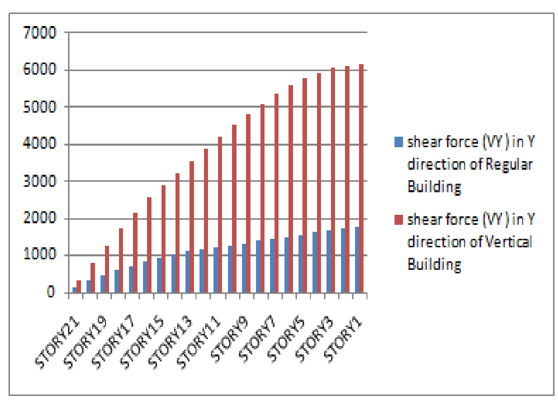
SHEAR FORCE IN X DIRECTION

Story	Load	Loc	shear force (VX) in X direction of Regular Building	shear force (VX) in X direction of Vertical Building
STORY21	RSA	Bottom	162.68	197.42
STORY20	RSA	Bottom	334.77	506.67
STORY19	RSA	Bottom	496.04	797.76
STORY18	RSA	Bottom	643.94	1112.01
STORY17	RSA	Bottom	776.65	1399.6
STORY16	RSA	Bottom	893.18	1657.07
STORY15	RSA	Bottom	993.55	1890.72
STORY14	RSA	Bottom	1078.76	2141
STORY13	RSA	Bottom	1150.81	2381.03
STORY12	RSA	Bottom	1212.55	2634.69
STORY11	RSA	Bottom	1267.36	2870.35
STORY10	RSA	Bottom	1318.84	3104.36
STORY9	RSA	Bottom	1370.26	3312.48
STORY8	RSA	Bottom	1424.06	3493.71
STORY7	RSA	Bottom	1481.5	3650.79
STORY6	RSA	Bottom	1542.44	3784.86
STORY5	RSA	Bottom	1605.43	3893.85
STORY4	RSA	Bottom	1668	3974.4
STORY3	RSA	Bottom	1727.02	4034.08
STORY2	RSA	Bottom	1778.83	4071.34
STORY1	RSA	Top	1818.35	4089.09
STORY1	RSA	Bottom	1818.35	4089.09



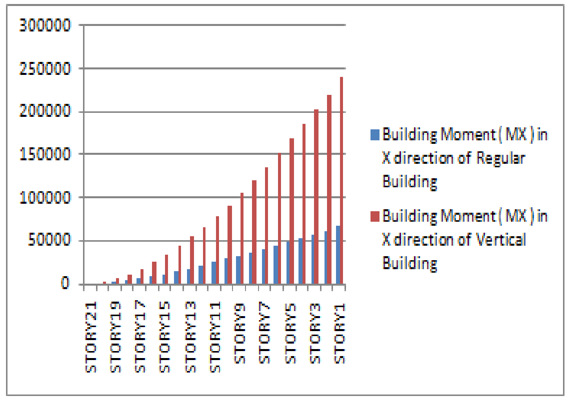
SHEAR FORCE IN Y DIRECTION

Story	Load	Loc	shear force (VY) in Y direction of Regular Building	shear force (VY) in Y direction of Vertical Building
STORY21	RSA	Bottom	148.11	308.01
STORY20	RSA	Bottom	306.48	787.82
STORY19	RSA	Bottom	456.63	1237.71
STORY18	RSA	Bottom	596.17	1721.03
STORY17	RSA	Bottom	723.3	2164.13
STORY16	RSA	Bottom	836.95	2553.24
STORY15	RSA	Bottom	936.84	2892.41
STORY14	RSA	Bottom	1023.57	3237.67
STORY13	RSA	Bottom	1098.56	3555.78
STORY12	RSA	Bottom	1163.95	3883.36
STORY11	RSA	Bottom	1222.39	4193.47
STORY10	RSA	Bottom	1276.75	4515.32
STORY9	RSA	Bottom	1329.71	4822.59
STORY8	RSA	Bottom	1383.41	5105.61
STORY7	RSA	Bottom	1439.09	5361.09
STORY6	RSA	Bottom	1496.9	5585.61
STORY5	RSA	Bottom	1555.96	5775.99
STORY4	RSA	Bottom	1614.46	5933.1
STORY3	RSA	Bottom	1669.98	6053.64
STORY2	RSA	Bottom	1719.64	6133.59
STORY1	RSA	Bottom	1759.31	6176.5



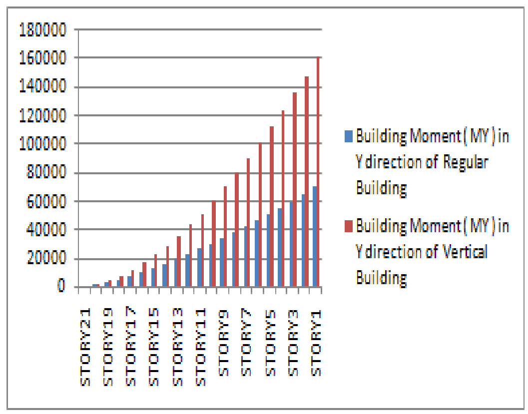
BENDING MOMENT IN X DIRECTION

Story	Load	Loc	Building Moment (MX) in X direction of Regular Building	Building Moment (MX) in X direction of Vertical Building
STORY21	RSA	Bottom	444.332	924.021
STORY20	RSA	Bottom	1363.76	3287.06
STORY19	RSA	Bottom	2733.48	6998.42
STORY18	RSA	Bottom	4521.31	12155.1
STORY17	RSA	Bottom	6689.23	18632.7
STORY16	RSA	Bottom	9195.29	26263.6
STORY15	RSA	Bottom	11995.7	34890
STORY14	RSA	Bottom	15047.1	44509.3
STORY13	RSA	Bottom	18308.8	55028.2
STORY12	RSA	Bottom	21744.4	66447.7
STORY11	RSA	Bottom	25324.1	78708
STORY10	RSA	Bottom	29025.1	91821.2
STORY9	RSA	Bottom	32832.6	105750
STORY8	RSA	Bottom	36739.7	120437
STORY7	RSA	Bottom	40745.7	135822
STORY6	RSA	Bottom	44855.5	151834
STORY5	RSA	Bottom	49076.5	168395
STORY4	RSA	Bottom	53416.8	185429
STORY3	RSA	Bottom	57882.6	202848
STORY2	RSA	Bottom	62475.8	220556
STORY1	RSA	Bottom	67985	241454



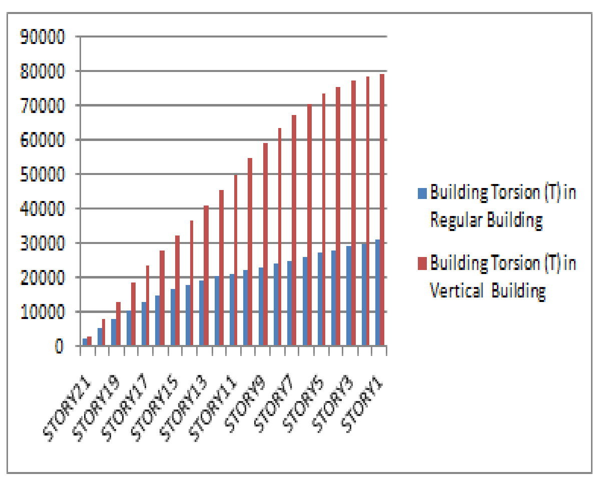
BENDING MOMENT IN Y DIRECTION

Story	Load	Loc	Building Moment (MY) in Y direction of Regular Building	Building Moment (MY) in Y direction of Vertical Building
STORY21	RSA	Bottom	488.049	592.267
STORY20	RSA	Bottom	1492.32	2111.6
STORY19	RSA	Bottom	2980.18	4502.53
STORY18	RSA	Bottom	4911.09	7829.07
STORY17	RSA	Bottom	7238.43	12004.9
STORY16	RSA	Bottom	9911.82	16931.8
STORY15	RSA	Bottom	12879.6	22528.4
STORY14	RSA	Bottom	16091.4	28818
STORY13	RSA	Bottom	19500.9	35767.2
STORY12	RSA	Bottom	23067.7	43406.4
STORY11	RSA	Bottom	26759.5	51702.6
STORY10	RSA	Bottom	30553.4	60656.6
STORY9	RSA	Bottom	34436	70207.3
STORY8	RSA	Bottom	38403.3	80279.9
STORY7	RSA	Bottom	42459.2	90800.4
STORY6	RSA	Bottom	46613.4	101698
STORY5	RSA	Bottom	50878.6	112905
STORY4	RSA	Bottom	55267.5	124352
STORY3	RSA	Bottom	59789.6	135989
STORY2	RSA	Bottom	64448.9	147768
STORY1	RSA	Bottom	70047.9	161629



BUILDING TORSION

Story	Load	Loc	Building Torsion (T) in Regular Building	Building Torsion (T) in Vertical Building
STORY21	RSA	Bottom	2716.76	3195.18
STORY20	RSA	Bottom	5599.9	8340.44
STORY19	RSA	Bottom	8311.2	13229.2
STORY18	RSA	Bottom	10808.1	18731.2
STORY17	RSA	Bottom	13059.1	23864.2
STORY16	RSA	Bottom	15047	28410.9
STORY15	RSA	Bottom	16770.5	32420.4
STORY14	RSA	Bottom	18244.5	36811.6
STORY13	RSA	Bottom	19500.3	40972.6
STORY12	RSA	Bottom	20582.8	45592.3
STORY11	RSA	Bottom	21546.2	49991.3
STORY10	RSA	Bottom	22448.1	54803.8
STORY9	RSA	Bottom	23341.5	59366.7
STORY8	RSA	Bottom	24266.4	63532.4
STORY7	RSA	Bottom	25244.5	67297.6
STORY6	RSA	Bottom	26275	70631.8
STORY5	RSA	Bottom	27336.3	73470.6
STORY4	RSA	Bottom	28389.6	75764.9
STORY3	RSA	Bottom	29385	77506.7
STORY2	RSA	Bottom	30263.9	78643.4
STORY1	RSA	Bottom	30944.6	79233.1



V. CONCLUSIONS

Based on the work presented in this thesis following point-wise conclusions can be drawn:

1. Period of setback buildings are found to be always less than that of similar regular building. Fundamental period of setback buildings are found to be varying with irregularity even if the height remain constant. The change in period due to the setback irregularity is not consistent with any of these parameters used in literature or design codes to define irregularity

2. The code (IS 1893:2002) empirical formula gives the lower-bound of the fundamental periods obtained from Modal Analysis and Raleigh Method. Therefore, it can be concluded that the code (IS 1893:2002) always gives conservative estimates of the fundamental periods of setback buildings with 6 to 20 storeys. It can also be seen that Raleigh Method underestimates the fundamental periods of setback buildings slightly which is also conservative for the selected buildings. However the degree of conservativeness in setback building is not proportionate to that of regular buildings

3. It is found that the fundamental period in a framed building is not a function of building height only. This study shows that buildings with same overall height may have different fundamental periods with a considerable variation which is not addressed in the code empirical equations

4. A detailed literature review on setback buildings conclude that the displacement demand is dependent on the geometrical configuration of frame and concentrated in the neighbourhood of the setbacks for setback structures. 147 The higher modes significantly contribute to the response quantities of setback structure. Also conventional pushover analysis seems to be underestimating the response quantities in the upper floors of the irregular frames.

5. FEMA 356 suggests that pushover analyses with uniform and triangular load pattern will bind all the solutions related to base shear versus roof displacement of regular buildings. Results presented here support this statement for regular buildings. However, this is not true for setback buildings especially for high-rise buildings with higher irregularity (S3-type)

6. Mass proportional uniform load pattern found to be suitable for carrying out Response Spectrum analysis of Setback buildings as the capacity curve obtained using this load pattern closely matches the response envelop obtained from nonlinear dynamic analyses.

FEATURE SCOPE OF THE STUDY

1. The analysis is limited to 20 storey building it can be increased to the 50 storey and above.

2. the pushover analysis can be performed on the building.

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